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EDITORIAL NOTE

THE articles in this issue of the BULLETIN, which are confined to the subject of accounting machinery and matters related thereto, have been supplied by the Society's special technical committee on Accounting Machinery, and embody the papers presented at the morning session of the Ninth Annual Fall Conference of the Society, held on October 14, 1931, in connection with which a very interesting exhibit of modern accounting machines was conducted under the direction of the Committee for the benefit of those in attendance.

The Committee on Accounting Machinery consists of the following members:

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VALUE OF ACCOUNTING MACHINERY TO ACCOUNTANTS

By CHARLES J. MAXCY, C.P.A., Chairman of the Committee on Accounting Machinery of The New York State Society of Certified Public Accountants

IN THIS machine age, when economists and other students of the world problems, are placing the blame for the present depression at the door of the labor saving devices, the subject of labor saving machinery becomes rather unpopular. It is my firm belief, however, that this little old world is not going to discard the wonderful developments of the machine age, but on the contrary is going to develop machines to a greater extent, thereby lightening the burdens of man.

As the life of our forefathers became more complex various methods were devised to arrange a common method of counting. We are all familiar with the two systems of numerical notation, namely, the Roman and Arabic figures. The use of characters to represent numbers is older than writing itself and our present decimal system is based upon the fact that our ancestors used their fingers to represent their simple computations. An interesting side light upon the use of the fingers is that in the later times of antiquity the finger symbols were developed into a system capable of expressing all numbers below 10,000.

As civilization developed throughout the world, computations became more complicated, embracing larger figures than could be conveniently carried in the mind or on the hands, so the necessity for the inscribing of characters upon parchment or other medium became apparent. Man supplied the deficiency, by evolving written characters.

Then man's ingenuity began to exert itself to develop some method of mechanically summing up and computing his transactions. It is curious to trace these methods throughout the world. The Romans developed the Abacus; the Chinese, a similar device called a Swanpan; and the Incas, the Quipus. We are familiar with the modification of the Abacus and Swanpan in the square frame with colored beads to be found in almost any nursery. The Quipus of the Incas, was a different device; it consisted of a string about two feet long with a number of colored strings attached throughout its length like a fringe. The colored strings were knotted and the colors, size, and the distance apart of these knots,—all had a signification. We are informed that the Peruvians recorded in a crude way marriages, births, and other computations on the Quipus.

At the morning session of the meeting of The New York State Society of Certified Public Accountants held at the Hotel Pennsylvania, New York City, October 14, 1931, the members of the Society were fortunate in having Mr. W. O. Lee, a Chinese gentleman, appear before them and explain the use of the Swanpan. Mr. Lee demonstrated the use of this ancient instrument in multiplying, subtracting, dividing, adding, and extracting square root. The speed and accuracy of this machine in the hands of a skilled operator is surprising.

An interesting side-light on the use of this machine is that the late Joseph McCoy, famous Treasury Department actuary, during his visit to China in 1904 in connection with the Boxer Indemnity, learned to operate a Chinese Swanpan and acquired native skill in its use. Anita E. McCoy informs us that from that date until his death he did most of his additions and subtractions by the Swanpan.

The modern machines that we know for computing and summing up of mathematical problems have been developing in the last three hundred years. The earliest known machines in the various classes are as follows: (1) Addition machines; the first invented by Blaise Pascel in 1642. (2) Addition machines modified to facilitate multiplication; the first by G. W. Leibnitz in 1671. (3) True multiplication machines; Leon Bolles in 1888, Steiger in 1894. (4) Difference machines; Johann Helfrich von Muller in 1786, Charles Babbage in 1822. (5) Analytical machines; Charles Babbage in 1834.

Accountants, particularly, should look back over the last quarter of a century with a sigh of relief. During this period rapid strides have been made in accounting machinery and I believe it is an indisputable fact, that the development of accounting machinery has been a material factor in raising the practicing accountant from the status of being merely an auditor to the high position he now occupies in the present business world.

Mr. Theodore H. Sterling in his report to the American Institute of Accountants on the undeveloped field awaiting exploitation by the accounting profession says: "The day has long gone by nor will it ever return when the accountant's principal function was considered that of auditing, a check-up of the past, an insurance against fraud, a certification of clerical accuracy. Today it is required that the accountant be familiar with all phases of business that he may fulfil his true function of financial advisor, business counsellor, constructively planning with management both the intimate details and the broader policies called for by the increasing complexity of commerce and industry, the impelling urge of competition and the consequently enforced closer study of such matters as costs, efficiency, markets, taxation, consolidations and the multitude of economic factors that constitute the daily problems to be met and solved by the business world."

In this day of mergers and large corporations, it is the belief of the writer that no certified public accountant can

render complete service to his clients, unless he has at least a working knowledge of the various classes of machines. It is however, too much of a task for every accountancy practitioner to keep abreast with all the improvements that are constantly being made. It was with this thought in mind that Col. R. H. Montgomery, President of The New York State Society of Certified Public Accountants, in 1923 appointed the Committee on Accounting Machinery.

Like all of the other technical committees of the Society, the Accounting Machinery Committee's function is purely advisory and educational. Each of the various members of the Committee is interested in a particular type of machine and because of this specialization the Committee is able to give a more comprehensive opinion than it could if every member were to try to cover the whole field. It is not the Committee's intention, nor its belief that it would be professionally ethical, to advise any member as to the selection of a particular machine. However, in the event any member should wish to know the Committee's opinion of the class of machine which will best perform the proposed work, it will give advice as to what machines there are in this class, and from then on the decision will rest with the member and his client.

A word of caution should be given in this connection. At the very start of any proposed installation of accounting machinery, there must be applied the acid test of whether the benefits to be derived will compensate for the expense of installation and operation. Too often machines have been installed where the volume of work did not warrant the use of a machine and, because of this, idle time for operators and machines resulted. This is detrimental to the best interests of the accounting machine industry as a whole, and, if an accountant has figured in the picture, it is a direct reflection on him.

Accountants in the past as a class have had a tendency to look with disfavor upon the accounting machine, taking the view that a machine installation tended to dispense with the accountant's services. This is a rather narrow view and may

have been true in the early days of this century, but the certified public accountant of today is called upon to perform a class of work which precludes his wasting much time on mechanical detail. The field of his endeavor is so broad, that he must conserve his time by mechanical helps wherever possible.

In conclusion, there is another point I wish to emphasize. Machines may compile all the figures in the world, and there is no doubt that the world is becoming machine conscious, but it remains for accountants to draw the conclusions from these figures. No machine has been developed, that can prepare a Balance Sheet or write the accountant's comments thereon.

TAKING THE MYSTERY OUT OF THE BOOKKEEPING MACHINE

By Frederick Dittmar Lehn, C.P.A.

IN AN EFFORT to shed some light on the general subject of bookkeeping and accounting machinery, I ask the indulgence of those of you to whom the fundamental principles of bookkeeping by machinery present no mystery. The substance of the following remarks is necessarily and intentionally exceedingly elementary.

Machine bookkeeping has no quarrel with the accepted principles of accounting. The operating features of a mechanized system of bookkeeping and the advantages accruing as a result thereof may best be illustrated by citing a specific example and comparing the machine method with the pen and ink method of accomplishing the same objectives. The preparation of accounts receivable records probably represents the most extensive application of commercial machine bookkeeping. Therefore, let us discuss an ordinary accounts receivable routine embracing a sufficient number of transactions to warrant the use of a bookkeeping machine.

The bookkeeping requirements are simple. Each day as sales on credit are made, the resulting charges are recorded in a sales register and the customers' accounts affected in the subsidiary accounts receivable ledger are debited. Cash payments, discounts, returns and allowances are credited during the month at the end of which statements indicating the details of balances owing are mailed out. The monthly totals of sales returns and allowances, cash received and discounts are posted to the general ledger accounts receivable controlling account, the balance of which should agree with the total of the balances in the subsidiary accounts receivable ledger as reflected by the monthly trial balance.

Now let us determine how these requirements would be met in accordance with both pen and ink and machine methods. The pen and ink bookkeeper would first enter the details

of all charge sales in the sales register which might or might not provide columns for making a distribution of the resulting charges. The necessity for this operation is entirely eliminated by the use of a bookkeeping machine which prepares the sales register as a by-product of the ledger posting operation.

Ordinarily, the bookkeeper would post the accounts receivable subsidiary ledger from the sales register. Note that any errors made in transcribing the totals of sales invoices to the sales register are naturally repeated when both the subsidiary accounts receivable ledger and the accounts receivable general ledger controlling account are posted.

The machine operator posts directly from a copy of the sales invoice. The invoices are listed on an adding machine and a verified total is taken before the posting operation is begun. When all invoices have been posted, the machine provides a total of amounts charged to the various customers' accounts affected. The machine total is immediately compared with the predetermined adding machine total as a means of checking the accuracy of the posting operation. This procedure is followed in every instance irrespective of the type of transaction. **All machine operations are proved daily** through the medium of comparisons with predetermined or after-determined totals of the sales slips, cash tickets, credit memos, etc., which provide the posting media.

Continuing the comparison—as a rule, the bookkeeper balances an individual ledger account during the month only when necessary. Usually the laborious task of adding total debits, subtracting therefrom total credits and calculating the resulting difference is left until the end of the month. Since little or no effort is ordinarily made during the month to check the accuracy of the work, the bookkeeper congratulates himself when the total of all the balances in the accounts receivable sub-ledger agrees with the balance indicated by the general ledger controlling account. Most of the time congratulations are not in order and much time-consuming work is required to locate the error or errors. Even then the book-

keeper's troubles are not over, for statements have to be written and balanced with the ledger accounts prior to being mailed out. All of these pen and ink end of the month operations take time, statements are not sent out promptly and the work of the following month accumulates.

The machine operator has no statement problem to contend with since the statement is written during the month at the same time that the ledger is posted and the sales register or cash receipts journal is prepared. Furthermore, because a new balance to date is extended after each entry or group of entries, end of the month statements may be mailed out as soon as the last posting for the period has been made. When the machine operator heads up the statements for the following month and brings forward the balances owing at the end of the preceding period, it is possible to combine this operation with the preparation of the trial balance of the subsidiary ledger. Furthermore, the accounts may be aged at the same time. Because the accuracy of all the bookkeeping machine operations is verified daily, no trial balance difficulties are experienced.

The advantages accruing from the application of bookkeeping machine equipment in the simple case illustrated may be briefly summarized as follows:

First. Several related records—the customer's statement, ledger and journal of charges or credits are written in one operation.

Second. The accuracy of the bookkeeping operations is verified daily rather than at the end of the month with the result that all accounts are in perpetual balance. The human tendency to err is effectively controlled mechanically.

Third. Information regarding the status of any account is immediately available.

Fourth. Neat, legible statements are mailed promptly on the first of the month.

Fifth. Management reports are prepared directly after the close of each accounting period.

It is well to remember that there are many types of accounts receivable applications which are designed to meet various requirements. Occasionally it is deemed necessary that both the customer's statement and the customer's ledger be prepared as original records. On the other hand, it might be highly desirable that the customer's invoice, monthly statement, ledger account and journal of charges or credits be written in a single operation. This is a condition that often exists, for example, in the retail coal business. Furthermore, in such a case the invoice is often prepared in duplicate and triplicate and an additional record such as a salesman's commission report may also be required. Then again, a so-called open item statement is frequently considered most advantageous. Modern bookkeeping machine equipment is sufficiently flexible in application scope to meet all reasonable record writing requirements.

Thousands of successful accounts payable, payroll, stock record, distribution and budgetary control applications demonstrate that the versatility of the modern bookkeeping machine is practically unlimited. Incidentally, the subject of budgetary control in particular is assuming increased importance at the present time and bookkeeping machine equipment plays no small part in the profitable application of budget principles as an aid to industrial management. Periodical budget and standard cost reports which clearly and forcibly indicate the differences between actual results and expectations must necessarily be presented promptly if full advantage is to be taken of the facts given. The vital daily and periodical reports by which industrial progress is gauged cannot be economically prepared in most cases with sufficient speed to be of practical service without the aid of record writing machines.

The matter of volume, with reference to the number of transactions necessary to justify the use of a bookkeeping machine, has already been referred to briefly. The question of just what volume of work is necessary to warrant the purchase of bookkeeping machine equipment cannot be answered defi-

nitely before a careful study of the factors involved in each case has been made. A bookkeeping machine has to pay its own way by reducing clerical expense or by increasing the efficiency of the bookkeeping routine and very often the latter result is of far greater importance.

The larger office equipment manufacturing companies welcome the opportunity to cooperate with the practicing public accountant who considers it his duty to familiarize himself with the operating features of bookkeeping machine equipment with the object in mind of rendering greater service to his clients. Much time and money has been invested in the preparation of booklets and pamphlets which present many phases of bookkeeping by machines. This material is yours for the asking.

PUNCHED CARD ACCOUNTING

By S. Carlton Kingston, C.P.A., of
Stern, Porter, Kingston & Coleman

THE TREND today is toward clerical cost reduction, and the accountant must be prepared to recognize ways and means whereby he can render such service to his clients. Punched card tabulating equipment is an approach to the automaton in accounting machines, and accordingly, provides a means to clerical cost reduction.

The purpose of this paper is not to exhaust the subject of the tabulating machine, but merely to call attention to this comparatively new tool at the accountant's disposal, and to point out that it is a topic worthy of study. The subject lends itself to five divisions, viz:

1. Description of the machines.
2. Distinctive advantages.
3. Application of tabulating equipment.
4. Factors determining the practicability of installing a punch card system.
5. Fundamentals to be considered in planning and installing such a system.

Description of Machines

In brief, a complete installation of tabulating machines consists of four units, viz: (1) the puncher, (2) the verifier, (3) the sorter, and (4) the tabulator. The latter machine may be either printing or non-printing.

All recording and tabulation is done by means of cards which are first punched, then sorted, and finally tabulated. The cards used for this purpose are provided with either 45 or 80 columns, and with twelve lines of figures, from zero to nine, the eleventh and twelfth positions being along the top

of the card, to increase the capacity when needed. Another type of card contains two rows of 45 columns or 90 in all. Also, one type of card provides for an alphabetical description section as well as for numerical symbols. The columns may be grouped or headed in accordance with any information desired to be tabulated. For instance, if the card is used for compiling sales statistics, the headings may be Bill No., Branch No., Territory, Salesman No., Style No., Quantity, Price, Amount, and in one type of card customer's name, in alphabetical letters instead of code, may be inserted. The arrangement of the card depends entirely upon the information desired to be tabulated.

The "punch" instrument is equipped with keys, from zero to nine inclusive, in addition to a skip key and keys for the eleventh and twelfth positions. Cards for use in alphabetical printing are punched by the alphabetical punch similar in design to a typewriter keyboard. Blank cards are inserted in a receptacle attached to the instrument and by means of a lever, one card at a time is fed into the machine. As the keys are struck, the carriage moves from left to right and a perforation is made automatically in the proper space on the card. The meaning of these perforations depends on their exact location under the respective titled headings or columns. The punching speed depends upon the quantity of data punched on the card. As many as 225 strokes or units a minute can be perforated.

Errors in punching are detected by means of repunching on the "verifier", similar in design to and operated in the same manner as the punch unit, except that instead of perforating the card the second time, the verifier locks when the perforation on the card being verified is in an incorrect position. If the card is incorrectly punched, a new one has to be made out.

The "sorter", by means of the perforation, mechanically sorts, asembles or arranges the cards in whatever sequence or classified grouping may be desired by the operator.

The sorter is equipped across the machine with twelve receptacles or pockets, and as the card passes over these openings, an electrical or mechanical contact causes the cards to be thrown into the various pockets corresponding with the numbers punched on the cards. The cards must be run through the sorter as many times as there are columns to be sorted. For example, if the cards are to be sorted by invoice numbers of five digits, punched in columns one to five on the card, and later sorted by salesmen's numbers of three digits punched in columns six to eight, all the cards must be run through the sorter five times for the invoice number, starting with column one, then two, etc., or by beginning with column five and working backward to one, whichever way is found easier, and later run through again for salesmen's numbers in the same manner. This process is continued until all sorts desired are completed. At first glance this would appear to entail considerable work, but the machine operates so quickly that the task is accomplished in an incredibly short time. The sorting speed is approximately 400 cards a minute.

The fourth unit is the "tabulator" used for adding the columns on the cards, and contains from four to six adding registers. These registers are set up so as to provide individual totals for each separate amount field on the card. The machine may be either non-printing or printing. If the machine is of the non-printing type, the individual items, of course, will not be shown and the total of each adding field on the card is only exhibited in the registers. The operator must copy the totals by hand to a separate sheet. If the machine is of the printing type, in addition to exhibiting the totals in the registers, the columns including code numbers, as well as amounts, are printed on a sheet previously inserted in the machine. If desired, each individual card can be listed, as well as only totals of groups. Automatic subtraction, direct or indirect, to obtain a net balance is another feature of these machines. The speed of the non-printing tabulator is 150 cards per minute, equivalent to 900 items

added per minute on six adding registers. The printing listing speed is from 75 to 120 a minute, depending on the number of columns listed.

There are a number of other devices and attachments that can be obtained to supplement these four main units, such as the duplicator used for mechanically duplicating the cards where more than one set is needed, the gang punch used for mass punching of information common to a number of cards, the counting device attached to the sorter to register the number of cards deposited in each pocket and the numbering attachment on the gang punch unit for numbering cards serially.

For those who desire a greater detailed description of this type of equipment than is possible in a paper of this size, the reader is referred to published literature on the subject and to the manufacturers who gladly exhibit and demonstrate their machines to those interested.

Distinctive Advantages

The principal advantages of this type of equipment are speed, lower costs, elimination of error and greater production. As previously indicated, these machines are operated at what may be regarded as a high rate of speed. Where volume and variety are involved, the speed at which the machines operate tends to reduce costs. Punched cards greatly reduce the chances of human error. Once the card is punched and verified it is not subject to alteration. The possibility of errors in transposition of figures in posting from one set of records to another is eliminated, as the processes of sorting, totaling and printing are done mechanically and therefore accurately. Time and money are thus saved in not having to locate errors. Greater production results, not only from greater speed, but also from the additional desirable reports than can be obtained readily without greatly increased cost. The cards constitute flexible and mobile records that can be used many times in reanalyzing the figures from different points of view. A

business can be analyzed from many angles that would be lost otherwise, due to the prohibitive cost of obtaining the revealing data by manual means.

Application of Tabulating Equipment

Tabulating machines are not to be classified as purely bookkeeping machines, as ordinarily understood in preparing books of primary entry. They are essentially adaptable for compiling statistical data and there is no class of mass analysis work to which they are unsuitable. However, although they can be operated independently from the regular accounting system and used simply to prepare information of purely statistical nature, they may be dovetailed therein and employed, coincidently with their major uses in analysis work, to prepare books of original entry character.

Among their major uses in industrial fields are: classification of sales by branches, departments, salesmen, products, etc.; distribution of expenses into nature of expense, departments, and other subdivisions; allocation of labor and material and proration of overhead to products in preparation of cost data; keeping of perpetual inventory records of stores and finished goods, and compiling of production records. In conjunction with these purposes, the machine may be employed in doing ordinary bookkeeping work such as maintenance of accounts receivable and accounts payable ledger records and in preparing payroll, sales and purchase registers.

The usual purposes for which these machines are utilized are somewhat well known, but the wider application of this type of equipment and the extent to which it is able to serve the executive are not so universally understood. For instance, the prime reason for installing the machines may be for sales analysis by classes of products. The value of these reports may be greatly increased by reanalyzing the figures from different viewpoints. The figures can be subdivided, without substantial increase in expense and more conveniently than by other methods, into geographical territories, branches,

departments, salesmen, and even customers, and thus be of considerable aid in calculating salesmen's commissions and in fixing sales quotas and budgets. By insertion of sales quotas and standard cost data in the master or summary cards punched from totals of detail cards, it is possible to localize the variance between sales budgets and actual sales, as well as to ascertain the effect on profits of volume, price, markup and variations in percentages of each class of product sold to the whole.

Likewise, the impression may be that the cards must be punched from the sales invoices after they have been prepared on the typewriter, etc., and entered in the sales book. This is not always necessary. With one type of equipment the card may be made out simultaneously with the invoice in one operation, or in other types the cards may be punched first from the original customer's order or shipping ticket, and the cards substantially used to prepare the bill to the customer and sales record. In such cases the cards serve the dual purposes of preparing books of original entry and statistical data.

In a factory, the tabulating card may be used as a work order issued by the production department for each operation to be performed in each department. The starting and ending time and other information can be entered on the card and when completed sent into the office for punching. The card thus serves as an original voucher as well as a statistical card. The same cards can be used to prepare both the payroll and entries for the cost system and cost analysis records. Where predetermined costs are used, the standard labor or hours and overhead can be punched into the card before it goes into the factory and be of service not only as a guide to the foremen and workmen but also to provide a comparison with actual results.

In the store room, the cards may be used for inventory purposes. By mechanically duplicating from the purchase invoices the "in" cards, the original may be used as an inventory

card and the duplicate used for analysis of purchases and related records not readily obtainable otherwise. Although stock requisitions themselves may be in the form of tabulating cards, ordinarily such requisitions involve more than one item of stock so that cards are punched again in duplicate from separate requisitions. The original "out" card is then used for credits to stock on hand and the duplicate is employed for cost analysis and related factory data. In some cases the finished goods stock "out" card can be employed also for preparing sales analysis and even the customers billing and sales ledgers.

There is even a wider application of this equipment in certain specialty lines such as insurance, transportation, chain store companies and governmental agencies. For example, in the fire insurance business, the companies may punch the premium card directly from the "daily report" of each policy written as received from the various agents, and may use this one card—

1. To prepare the policy registers subdivided by agencies for checking of agents' accounts current.
2. To compute the reinsurance reserve required by law to be set aside from surplus to cover an aliquot portion of the premium on every policy issued representing the amount thereof unearned at any given date.
3. To distribute net premiums by states, towns, counties and even cities for tax and underwriting boards' assessment purposes.
4. To subdivide the state figures into classes of risks written in accordance with the National Board of Fire Underwriters' requirements.
5. To resubdivide the classification of risks written into agencies for underwriting experience and agency management.

In reference to losses, the cards may be punched from the original estimated loss notices, and filed in an outstanding

loss file until the loss is actually paid, thus constituting a record of unpaid losses. Upon payment of the loss, the card is withdrawn from the outstanding file and the amount of loss paid is punched on this same card which is then used in obtaining registers of paid losses broken down into the same subdivisions as outlined above for premiums. The underwriters are thus able to receive very important data as to underwriting results by territories, agencies, and classes of risk that would otherwise be lost due to excessive cost of accurate compilation.

The possibilities of these machines and their application to even ordinary businesses of moderate size can be ascertained only by study of each individual company's requirements. The subject has not been fully developed and it constitutes a field for investigation by the practising accountant.

Factors Determining Practicability

These machines are not adaptable to every class of work. The problem is to ascertain the activities to which they should be applied and the factors to be considered in determining their practicability. The primary factors are volume and the variety of distributions, or data, to be made from one set of records. Where the work entails tremendous volume involving multiple distributions or classifications, the installation of tabulating machines is most desirable.

Careful consideration must be given to the element of comparative costs. There must be sufficient volume to warrant their operation as the installation entails a rental cost, the amount thereof depending on the style and number of machines used. Accordingly, care must be exercised to determine that the rental cost plus personnel salaries will not exceed the cost of other means that can be employed efficiently to accomplish the work in hand. Although certain types of machines can be obtained for as low as $55.00 a month for a complete installation, it is usually wasteful for a small concern with comparatively few and infrequent trans-

actions to adopt this system. Likewise, if only one "sort" of distribution is to be made for report purposes, it may be found that less expensive methods can be utilized. Quite frequently the cost element is compensated by the additional data that can be efficiently incorporated on the card, thereby enabling the gathering of other desirable information, coincident to their operation.

The time urgency and accuracy elements are important. Can the tabulating machines produce the results more quickly and accurately than other methods?

Another deciding factor in determining their practicability is the supplemental uses to which the machines may be put, such as in preparing sales bills, purchase and sales registers, payroll and other books of original entry. Investigation may develop that manual or other bookkeeping methods in force can be dispensed with and the tabulating machine system substituted therefor, so as to take up any idle time of the machines. However, care must be exercised in this regard to see that the equipment is not overburdened, otherwise one set of figures will be held up awaiting the compilation of other data, and in this way delay the rendering of all reports. It is not usually desirable to install these machines for their supplemental bookkeeping uses unless they are actively engaged in statistical analysis work.

By weighing all these elements the accountant can determine whether or not the punch card system will work to advantage.

Fundamentals in Planning and Installation

After it has been determined to install the system, the planning and laying out of the actual installation is of equal importance. Contrary to belief, the installing of punch cards does not necessarily involve radical changes in procedure, except when such changes should be made, in any event, for the good of the business. No two installations are exactly alike because of varying requirements and personalities. How-

ever, there are some general rules to follow in all installations which should make the public accountant of the utmost value to his client in planning a successful installation.

The ability to lay out a punch card system presupposes a knowledge of the uses to which the data compiled is to be put, and, accordingly, of what data should be gathered. It is necessary to possess a concise knowledge of the various record activities of the business. This requires investigation of many phases of the existing system to ascertain why it is handled in the present manner and to what use the data compiled is put. Such a study will prove enlightening and may disclose many weaknesses. It may be revealed that some information being gathered is no longer of importance, and that certain essential data is not being compiled. Again, the system of identification numbers may be cumbersome and need simplification, and the routing of the work through the office may be illogical. In any event, the investigation of the record activities of the company is essential before planning any installation.

The next step after determining what information is to be gathered is to lay out the procedure or routine. Practices must be standardized so that the work comes to the machines in routine manner. Regular ways also must be found to handle exceptions which frequently arise. The proposed machine system should be synchronized or dovetailed into the general accounting procedure so that each step is a direct outgrowth of another without friction. Consideration should be given to employing the machines effectively in preparing books of primary entry. As previously outlined, there are many instances where the cards can be punched directly from the original voucher and the books of original entry prepared from the cards, instead of the reverse of this procedure, thus eliminating an intermediate step. This may have the added advantage of absorbing idle time of the machine when not in use for statistical work. Of most importance is the maintenance of adequate controls so that the accuracy of

the work can be checked daily. If proving is left until the end of the period, considerable precious time may be lost in locating errors when time is most vital. The maintenance of internal checks is just as important in a punched card system as in any other system. The system should be made an aid to auditing and not a hindrance as is so frequently done. When the system embraces the writing up of the general books by means of the punch cards, the printed tabulations should be in as much detail as when the manual method is used, to the end that original vouchers can be readily identified in and checked to the books. The recording of totals only in the books without adequate means of identifying the individual items making up the totals should be avoided. If this is avoided the auditor will find that the punched card system is of material assistance to him.

The type of equipment best suited to the requirements must be considered at this point. The design of both simple codes and cards is to be considered simultaneously therewith. The system should be planned to eliminate laborious decoding so that reports are rendered in finished form. A little foresight in providing for comparisons with budgets, standards and previous year results, makes the reports available for the executive immediately upon leaving the machines, without further calculation or typing. Thought should be given to what supplemental data can be inserted in the card to permit the compilation of data desired by the management heretofore unavailable because of the prohibitive cost in gathering by manual methods. Cards designed for multiple purposes and synchronized with others prepared for different purposes, (so as to eliminate the changing of the wiring set up of the tabulators) greatly increase their effectiveness and reduce the cost of tabulation.

Last but not the least is the training of the operators. The operators must be capable of carrying out the program without undue supervision and be able to dispose of operating difficulties as they arise. The executive accountant is thus free to devote his time to the interpretation of the data.

The practicing accountant can be of utmost value to his client in planning a successful installation. He is fitted by training for devising systems. He possesses the knowledge of what information should be gathered and how to interpret the data when gathered. The need is for procuring timely accurate and concise data in the easiest, quickest and least expensive manner. Thus the trend is toward clerical cost reduction. It is desirable for the accountant to be prepared to follow this trend, and to be alert to recognize circumstances whereby machine methods can effect savings. In advising along these lines, the practicing accountant can be of real service. The tabulating machine is a means to this end and is worthy of the accountant's consideration.

THE IMPORTANCE OF MACHINE CALCULATING

By Henry C. Lang, C.P.A.

MUCH of the success of present day accounting systems is due to the enormous savings in time and energy effected by the use of mechanical equipment for the handling of the labyrinth of computing problems of modern business.

In the years before the use of adding machines became almost universal, many accountants were proud of the rapidity with which they could mentally add columns of figures. Doubtless, adding machines did not always show a great saving in time, although the advantages of accuracy and mental relief soon became apparent. However, the gap is so wide between mental and mechanical multiplication and division, that even the most proficient "scratch pad" expert concedes the vast superiority of machine calculating. The average ratio is at least four to one.

Because of this realization of the tremendous possibilities for time and labor saving, European scientists, particularly the Germans, at an early date put forth their efforts to the development of devices for mechanically performing multiplication and division. Although as far back as the time of the Egyptians and Romans, various devices were invented for mechanical computing, Europeans of the last century were really pioneers in the development of the modern crank-type calculator, and for this reason, prior to 1914, most of the computing machines used in this country were of foreign manufacture. Since then, however, rapid progress in the design and manufacture of such equipment has been made in this country. The machines now available have been developed to a high state of efficiency.

Before the World War, many accountants in this country were inclined to regard a calculating machine as a sort of luxury that only large corporations could profitably use. However, in the last ten years, the greater realization of the value of statistics, the development of cost accounting and the

tremendous growth of details necessary to the operation of even comparatively small business, have resulted in the universal acknowledgment of the necessity for calculating equipment in practically every office.

The following is an outline of some of the important operations performed by machine calculation in various fields of industry and commerce:

MANUFACTURING CONCERNS—Invoicing; extending payrolls; figuring inventories, costs, statistics and taxes.

DEPARTMENT STORES & CHAIN STORES—Accounts Payable, including the checking of cost and the figuring of retail values; discounts; mark-up and mark-down percentages; anticipation; inventories; profit and loss statements; statistics, including percentages and pro-rating.

RAILROADS—Checking way bills; figuring interline accounts; operating costs; statistics.

GAS & ELECTRIC COMPANIES—Billing; costs; statistics; payrolls.

INSURANCE COMPANIES—Actuarial calculations; interest on loans; amortization of bonds; figuring reserves; premiums; commissions; re-insurance; endorsements; ratios; dividends; statistics.

BANKS & BROKERAGE CONCERNS—Interest on savings accounts, commercial loans, and Real Estate loans; accruals; amortization; analyses of accounts; costs; foreign exchange; discounts; statistics.

JOBBERS AND WHOLESALERS—Inventories; invoicing; statistics.

GOVERNMENT OFFICES — Taxes; interest invoice checking; statistics.

All modern crank-type calculating machines are so constructed that the average person can learn the simple operations of multiplication, division, addition and subtraction with apparently little practice. Most machines are equipped with a

keyboard and two dials. In multiplication, one factor is set on the keyboard and the other is registered in one of the dials. The product appears in the other dial. In division, the dividend is set in one of the dials and the divisor on the keyboard; the quotient is registered in the second dial. In multiplication, a proof is usually given of the accuracy of the figures used, and most errors can be corrected without repeating the entire operation.

Besides performing the simple functions of multiplication, division, addition and subtraction, the modern calculating machine is capable of combining several of these functions into a single operation and thus performing many computations impossible to the human mind. Many accounting problems involve such computations as a series of multiplications and the totaling of the results; a multiplication followed by division; the result of one multiplication subtracted from the result of another, and so on. Enormous savings can be effected in the solution of such problems through the proper combination of the operations involved. For example, in checking an invoice without the aid of a machine, it is necessary to compute each extension and then add the results in order to check the total amount of the bill. A calculating machine will total the extensions as they are figured, so that the time ordinarily consumed in adding is eliminated.

In accounts payable in department stores, in which both the cost and retail value of all merchandise purchased must be known, large capacity machines are used which figure both the cost and retail value of all items in one operation and simultaneously determine the total cost and retail value of all merchandise appearing on the invoice. Accounting problems in all lines of business offer countless other opportunities for the simultaneous performance of several operations possible by machine computing.

In order that users may derive the maximum efficiency from the use of machine computing, the various calculating machine companies employ experts in the art of application

of figures to machines and these specialists analyze each type of computation in an office and instruct machine operators in the proper solution of their problems.

The enormous savings resulting from the proper application of machines is particularly apparent during periods of peak loads. Monthly costs, profit and loss statements and other information vital to the proper management of a business must usually be compiled within a comparatively short time. In these days of keen competition, the saving of even one day in the compiling of reports is often of great importance. It is at these times that machine calculating shows the futility of mental computing. Reports that otherwise would require days to compile can often be completed within a few hours with the aid of calculating machines.

Through the installation of calculating machines, much helpful statistical information can be gathered that the element of time would, otherwise, not permit.

The benefits, therefore, derived from the use of mechanical calculation are so numerous that there is no doubt that the time is not distant when calculating machines will be considered as much of a necessity in the average office as typewriters and adding machines are at the present time.

THE SLIDE RULE

By Lewi Gluick, C.P.A.

IN THIS article the writer assumes that the reader knows what a slide rule is. It is his purpose to describe what it can do; to illustrate its practical utility.

Some people have the idea, derived from the jesting description of "logarithms on a stick", that a "slip-stick" is an intricate device, for erudite mathematicians, and for esoteric use. Nothing could be further from the truth. Mathematicians use slide-rules; they could hardly work without them. But anybody with an eighth grade knowledge of arithmetic and ordinary intelligence can learn to operate a slide rule in a hour from the booklet of instructions accompanying each new one. The writer has taught the principle of the instrument in fifteen minutes. Of course, practice is necessary for high speed and accuracy.

There are three types of slide rules: straight, circular and cylindrical. The first is the most common and our discussion will be confined to it. Circular slide rules possess advantages; and cylindrical ones also. But these last are costly and a modern electric calculating machine will give higher speed and accuracy for most purposes.

Straight rules come in three sizes: 5 inch or pocket; 10 inch or ordinary; and 20 inch or large size. The one most commonly in use is the medium size (30 centimeters). It slips easily into any audit bag or overcoat pocket, and can be used for ordinary ruling (straight edge) purposes or measuring.

Slide rules come in various prices depending on material and degree of calibration. This latter is vital to engineers and physicists, but accountants will find a $4.50 model quite satisfactory. The writer has used his for many years and would not part with it.

The slide rule does not add or subtract. It does multiply, divide and perform involution and evolution. Its most impor-

tant function for accountants is the computation of ratios. For this it is invaluable.

Accountants and business men have slowly been educated to realize that absolute figures are but little better than none at all. Comparative figures lose half their value if not reduced to ratios. Several years ago Alexander Wall worked out a series of eight significant ratios for the Robert Morris Associates. Since then these ratios have been widely used by bank credit men.

In a bank, commercial rating agency, or the credit department of a large corporation, where such statements go through in wholesale quantities, calculating machines are used. The accountant in public practice cannot readily carry one with him. If he has one in his office, it is needed there. The slide rule in his bag will give him just as good results for practical purposes.

A few fussy people say that since a slide rule is accurate to only three significant figures, it is impractical for accountants. However, three significant figures are just one more than the average business man cares anything about.

The writer knows this from experience. With a single exception, every accountant, in his wide acquaintance, agrees. Granted that at times eight decimal places are required, why give the business man four places when he desires only two? It may not be the most accurate thinking on his part, but he will do it nevertheless. What he wants and his auditor should give him are figures that are not only correct, but intelligible. A slide rule will do just that. For example:

Net Sales	$12,733.84
Cost of Sales.....	10,569.21
Gross Profit	$ 2,164.63

The ratio of Gross Profit to Net Sales is 16.99. On a slide rule we get 17. What difference does it make? Or again:

Sales—September, 1930	$12,733.84
" " 1931	11,650.92
Decrease	$ 1,082.92

The decrease is 8.504% on a calculator. It is 8½% on the slide rule. Do you think the business man cares about the extra nought four? On the contrary if he tells anybody about it, he will probably say his sales decreased eight per cent.

This past summer the writer worked on a large estate accounting. That is a place where precision to the ultimate decimal place is imperative. Surrogate's courts are jealous of the last cent in distributing a decedent's property. So he ran out one ratio to 5.89. But throughout all the proceedings the lawyer to whom the report went talked about "six per cent" or occasionally "approximately six per cent" and when queried as to what he meant by "approximately", replied "five and nine tenths". In other words that last one hundredth just did not register.

Having established the practicality of the slide rule, let us now consider its advantages for the accountant, be he in charge of a private corporation's auditing department, or in public practice. If he is worth his salt he knows the importance of ratios. If he wants to do justice to himself and his employer, he will not waste time with pencil and paper. And in most cases, a slide rule will be the cheapest solution to the problem.

The writer is in a client's office in course of auditing the books. The credit man comes to him with a statement from a customer. "What do you think of this?" Now he could go and borrow the client's calculator and work out the ratios. He might make mental calculations. But instead, he picks up his trusty slide rule and works them out and in a few minutes has given a sound opinion, satisfied his client, and gotten back to his work.

This matter of impressing the client is of deep psychological import. If the business man is, as the popular song has it, "Ninety-nine out of a Hundred", he thinks of a slide rule as some kind of white magic, akin to a jacquard knitting machine. A man who can use one is clever in the client's mind, and he likes to think of his auditor as being that.

On the other hand, if he is of the one per cent who knows that however intricate the construction, the operation of a slide rule is no more difficult than a dial telephone, he will be pleased to see his auditor use one. What is more important, he might become impatient if the accountant had to resort to pencil and paper, or borrow the calculator. Little things make big impressions when it comes to obtaining, maintaining and retaining the client's good will, and to justifying fees.

Another valuable use of the slide rule for auditors is in prorating insurance. Many auditors go to the trouble of working out every policy for unexpired value. If the client has not done so already this might be good practice, and accuracy to the exact cent may be desirable. But when the accountant finds that the client's bookkeeper has prepared a schedule, all he need do is check it.

To do this in detail is a time-consuming, laborious job, and only duplicates work. A test such as the slide rule provides, correct to three significant figures, is sufficient. If the variation is great, exact calculations may be made.

For example, the unexpired value of a policy having an initial premium of $262.73 and having 77 days to run is $55.42. The slide rule gives us $55.40, which is close enough for any check. On the other hand, if our check gave us $55.40 and the schedule had $35.40, we would recheck by calculator or pencil and paper.

To many business men an audit represents a necessary evil. The executive realizes that he cannot get along without it. His bankers would not let him, even if he should want to do so. Therefore the accountant who can come into a client's office and do a thorough job in the least time is the man he wants. Any mechanical device which will assist the auditor is welcome. A slide rule is merely an important one, not the only one. But it merits consideration and deserves a place in every audit bag.

During the period closely corresponding to the financial

boom, the big thing in baseball was the home run. When everybody was buying, at any price, executives disregarded costs and ratios. When the ball was lively, why bother to steal bases? A home run was easier.

But this year all has changed. The big figure in baseball is base runner Ben Chapman. Business men are watching cost percentages with a proverbial eagle eye. In base running, ability to slide safe is vital. In computing ratios, too, a very good rule is to slide.

THE SWANPAN

By W. O. Lee, M.C.S.

A WESTERNER during his sight-seeing trip to China-town in a metropolis entered a Chinese shop and after considerable browsing he made several purchases. Before he could make his own calculation of the purchases an elderly Chinese, behind the counter, made some clicking sound and announced the total. The Westerner was amazed. Looking over the counter he discovered the Swanpan. His curiosity was aroused and despite the willing explanation of the Chinese in broken English he decided it was just another Chinese riddle.

The Swanpan is no mystery as we shall see later. In every Chinese establishment you will invariably find Swanpans used. It has become an essential equipment in business. Without it calculation would be most difficult, provided the cipher system of notation is not substituted, because the Chinese written figures are cumbersome.

According to traditional history Emperor Fu Hsi invented the pakua, the mystic trigrams still used in divination, in the third millennium B. C. In the reign of his grandson, Huang Ti his subjects Tai-naó devised a sexagesimal system and Li-shu invented arithmetic. This was the beginning of Chinese mathematics.

No study in history has revealed the origin of the Swanpan or its inventor. However, in the contemporary literature of about 220 A.D. we find it was first mentioned as an instrument of calculation. Prior to the use of the Swanpan twigs, sticks, beads and stones were utilized as means of calculation. The introduction of the Swanpan must have brought forth hilarious cheers from both bookkeepers and proprietors in the early days.

In comparison to the modern calculating machines the cost of a Swanpan is negligible. Rarely if ever does it need repairing of any kind. It does not limit itself to addition but includes subtraction, multiplication and division. The instrument is

light and easy to handle. An accountant can just slip the Swanpan in his brief case and use his own instrument where other machines are not readily available. By using a little patience to study the operation of the Swanpan it would be found simple; with a little practice, the speed would be amazing.

However, it has its disadvantages. There are no means of checking or locating errors except by repeating the entire process. So in order to insure accuracy the calculation must be made twice or more. Furthermore, to master the Swanpan it is generally required to memorize the numerous rules and tables of operation. But with thoughtful consideration the indications would be readily understood and its manipulation fascinating. The disappearance of the original figure as the calculation progresses may not be termed a disadvantage since it is only the result in which we are interested.

The Swanpan is an arrangement of sliding counters on a framework for the purpose of arithmetical calculation. It is generally constructed of wood, the frame of which takes a rectangular shape and is divided by a narrow bar into two sections, one of which is slightly more than twice as large as the other. Nine or more cylindrical rods are placed equally apart passing through the openings bored in the dividing bar and are attached rigidly to both sides of the frame. On each rod are seven counters which slide smoothly up and down upon manipulation. Five of these counters slide on the longer rod in the larger section, while the other two on the shorter rod. All the counters are of uniform size and color.

In order to prepare it for operation place the Swanpan before you on a flat desk with the smaller section furthest from you. Now tilt it slightly so that the five counters (also termed lower counters) on each rod slide down to the frame nearest to you while the double counters (also termed upper counters) slide down upon the dividing bar. Replace the Swanpan on the desk and drive the upper counters back to the other extreme of the rods by a gentle brush of your fingers upon the

counters. The upper counters are now pressed against the upper frame while the five counters of each rod press upon the lower frame. Each of the upper counters represent the number of five; in other words, each has five times the value of any single lower counter on that rod; whereas each of the five lower counters represent the amount of one. In this position the Swanpan is ready for operation as is indicated in Figure 1.

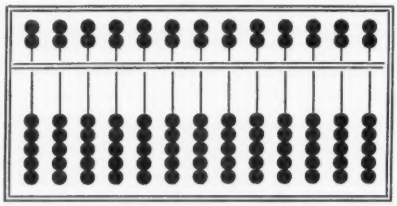

FIGURE I.

Addition

Take any set of five lower counters from the middle of the Swanpan and push up one counter till it reaches the bar. As is indicated in Figure II this may represent a unit of 1, 10, 100 and so on, or it may represent .01, .001; however, it will

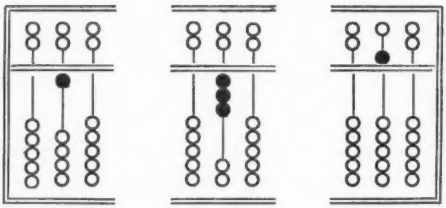

FIGURE II.

be equally essential to remember on which rod the unit of one lies as well as where the decimal point begins. Now let us return to 1 and pushing up another counter on the same rod will give us 2, and so on. Pushing up the last one will naturally give us 5, however, we can also realize this number

by moving back the five counters to their original position and bringing down the lower of the double counters to the bar.

Continuing our procedure 6 is realized by moving up one lower counter, 7 by moving up two. By pushing up the last one 10 is reached and it can also be represented by bringing down the remaining counter of the double counter and returning the five lower counters to their former position or better still by pushing up the double counters to the top of the upper frame and moving one lower counter up on the next rod to the left as is indicated in Figure III.

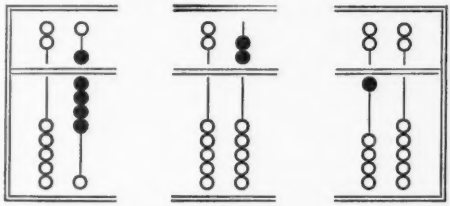

FIGURE III.

To clarify the foregoing points let us take as an illustration the number 4703.91 as is indicated in Figure IV.

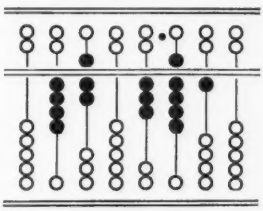

FIGURE IV.

The problem is to add the number 1029.53 to the figure illustrated.

For the purpose of simplifying the explanation, the values on each counter as the problem is performed are shown to the

right of the explanation. (Figures not preceded by minus signs are to be added.)

The number 4703.91	4	7	0	3	9	1
To add the number 1029.53						
On the thousands rod push up one lower counter making 5 or move back the five lower counters to their original position and bring down the lower of the double counters to the bar	1					
In the tens column push up two			2			
On the unit rod we cannot push up nine, but since 10 — 9 = 1, we push up one on the tens rod and at the same time remove one from the unit rod			1	—1		
At this stage the amount reads 5732.91	5	7	3	2	9	1
In order to add five to the tenth rod, bring down the remaining double counter on that rod					5	
As the result on the tens rod is 14, move back the double counters and bring up one lower counter on the unit rod to the left				1	—10	
Push up three on the hundredth rod						3
And we arrive at the result of 5733.44 as is shown in Figure V	5	7	3	3	4	4

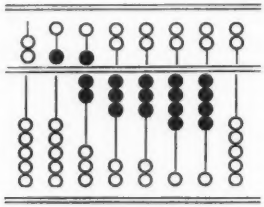

FIGURE V.

Subtraction

In subtraction the procedure is performed in a similar method, that is, to remember the number which with the given number makes up 10. By looking at the figure on the Swanpan it is easy to know whether the subtraction of the number can be effected, then to subtract from the larger number and add the complementary number to the place necessary.

Multiplication

Multiplication is governed by a Multiplication Table of nine numbers since a higher number is not necessary on a Swanpan. Unlike the Westerners who say two times six equals twelve, the Chinese merely repeat two six, twelve and this method is peculiarly adapted to the Swanpan.

In the multiplication technic the multiplier is generally placed on the left apart from the multiplicand. To the right of the multiplicand there must be at least zero rods equal to the number of digits in the multiplier. In the operation the multiplier beginning at the left figure multiplies each figure of the multiplicand beginning at the extreme right figure. Let us take an example by multiplying 369 by 27. Arrange the multiplier to the left and at least two empty rods to the right of the multiplicand. The Swanpan will then show the position of the counters in Figure VI.

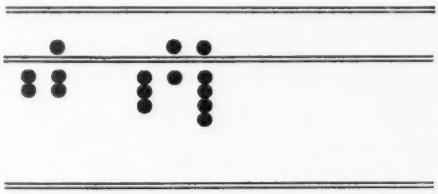

FIGURE VI.

Position of counters in Figure VI.....	2	7	3	6	9		
Multiply 9×2							
First remove 9.....					—9		
Place 18 on the rod with the 1 on the rod where 9 was and 8 on the next rod to the right.....					1	8	
Multiply 9×7, add six to the 8 and three on the next rod to the right..						6	3
As the next to the last column amounts to 14, bring up one on the rod to the left and simultaneously remove the double counters from the next to the last rod.....					1	—10	
The Swanpan now reads 36243.....	2	7	3	6	2	4	3

Multiply 6 × 2								
First remove 6				—6				
Place 1 on rod from which 6 was removed and add two to the 2 rod				1	2			
(When one becomes expert operations may be combined to advantage—in this case, instead of removing 6 and adding one, five would normally be removed in one operation)								
Multiply 6 × 7, move four to the four rod (third from the right) and two to the 4 rod (next to last rod)					4	2		
We now have the figure 31863	2	7	3	1	8	6	3	
Multiply 3 × 2								
First remove 3			—3					
Add 6 to the 1 rod				6				
Multiply 3 × 7, add 2 to the previous 1 rod and 1 to the 8 rod				2	1			
And the product is 9963, as is illustrated in Figure VII	2	7		9	9	6	3	

It will be noted that the multiplier remains on the Swanpan throughout the calculations.

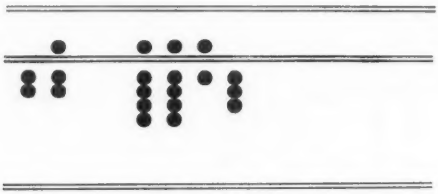

FIGURE VII.

Division

In division peculiarities and complexities arise but it is exceedingly interesting. The operation is based upon the Nine Returning Division Table which is required to be memorized. To explain the construction of the Division Table examples as translated literally are given below.

Division Table for One
One one gives one ten
One two gives two tens
continue on to
One nine gives nine tens

Division Table for Five
Five one add one
Five two add two
Five three add three
Five four add four
Five five gives one ten

Division Table for Seven

Seven one below add three
Seven two below add six
Seven three, forty-two
Seven four, fifty-five
Seven five, seventy-one
Seven six, eighty-four
Seven seven gives one ten

Division Table for Nine

Nine one below add one
Nine two below add two
continue on to
Nine eight below add eight
Nine nine gives one ten

The foregoing Division Table given without further explanation would be just as much Greek as Chinese. When the operator says "seven-three, forty-two" he actually implies that seven into thirty gives four and two left over. Let us try a problem and divide 952 by 7.

Position of counters at beginning of problem.....	7		9	5	2
The division table states "seven seven gives one ten"					
We then remove seven from 9 and push up one on the rod to the left.....		1	—7		
The Swanpan now reads.....	7	1	2	5	2
We are still considering the remainder 2 from 9 and repeating the formula "seven two below add six." Six is then added to the next rod on the right.....				6	
We then push 1 on the hundreds rod and remove 7 from the tens rod.....			1	—7	
The result so far appears on the Swanpan as 1342.	7	1	3	4	2
Taking up the tens column, we repeat the division table "seven four, fifty-five"					
First remove the four in the tens column.....				—4	
Bring down one upper counter (five value) on both the tens and the unit rods.....				5	5
The Swanpan now reads 1357.....	7	1	3	5	7
The last step is "seven seven gives one ten",					
One is moved up on the tens rod and 7 is removed from the unit rod.....				1	—7
As a result the quotient is 136, and would appear on the Swanpan as indicated opposite.....	7	1	3	6	0

It will be noted that the divisor remains on the Swanpan throughout the calculations.

There is also a method known as the Return and Subtract method used in situations where two figures are used as divisor. For an illustration let 9720 be divided by 72. To

explain the steps comprehensively we shall divide the procedure into three parts.

Position of counters at beginning of problem	7	2		9	7	2	0
(a) "Seven seven gives one ten", that is, remove seven from 9 and push one to the next rod on the left			1	—7			
The figure now stands at 12720	7	2	1	2	7	2	0
One is now the first dividend and we have subtracted 7 from 9 and now saying "one two subtract two', we subtract 2 from 7					—2		
Leaving 12520	7	2	1	2	5	2	0
(b) Now we still have to contend with 2 in the thousands rod and repeating "seven two below add six" we add six to the hundreds rod					6		
Giving us 1-2-11-2-0	7	2	1	2	11	2	0
Next remove 7 from the hundreds rod and move one up on the thousands rod				1	—7		
Resulting in 13420	7	2	1	3	4	2	0
The following step is "three two subtract six, add four below", in other words, subtract six from 42 but the Swanpan does not look so far ahead, so we subtract six from 40 by removing one counter from the hundreds rod and add four to the tens rod					—1	4	
Leaving 13360 on the Swanpan with 13 as the quotient so far	7	2	1	3	3	6	0
(c) The final part is "seven three, forty-two" or add one to the hundreds rod (removing 3 and adding 4) and two to the tens rod					1	2	
Giving us 13480	7	2	1	3	4	8	0
Next "seven seven gives one ten" tells us to move up one on the hundreds rod and simultaneously remove seven from the tens rod					1	—7	
With 13510 as the result	7	2	1	3	5	1	0
The last step is "five two subtract one ten" or remove one from the tens rod						—1	
Resulting in the quotient of 135	7	2	1	3	5	0	0

Square Root

The extraction of a square root on a Swanpan requires knowledge of the Half-squares Table and of the squares of the nine digits. It is based on the algebraic principle that the

square of a binomial is the sum of the squares of the two components together with twice their product. $[(a+b)^2 = a^2 + b^2 + 2ab]$ Let us try an example by extracting the square root of 3844. As in the cipher system, separate the number into periods of two figures each, beginning at units.

Position of counters at beginning of problem			3	8	4	4
It is obvious that the greatest square in the left hand period is 6. Now move up 6 on any rod at the left	6					
Next, subtract 6^2 or 36 from 38			—3	—6		
The Swanpan now reads 244	6			2	4	4
Halve this remainder				—1	—2	—2
Leaving 122	6			1	2	2
Try 6 as divisor of 12 which gives 2						
Subtract 2×6 from 12				—1	—2	
Leaving a remainder of 2	6					2
Finally, subtract half the square of 2 or two from 2, leaving no remainder						—2
Move up 2 on rod at right of 6 rod		2				
Hence the Square Root is 62	6	2	0	0	0	0

Conclusion

In this article the writer has endeavored to outline the scientific and more practical aspects of the Swanpan as a calculating device in business without attempting to go into details. However, it is hoped that a clear conception has been presented.

For 2,000 years the Swanpan has served the Chinese in their commercial enterprises and the service has been found so efficient and helpful that it has not undergone any change in its original construction. Even to-day despite the headway made by modern machines the Swanpan still maintains its popularity in China. Not to do injustice to the ingenuity of our calculating machines, perhaps the slow development of modern accounting methods in China has retarded its growth. Public accountants have now established accounting as a profession. The Chinese government has recently recognized it as such in conducting the first examination for Certified Public Accountants and enacting regulations to govern their practice.